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**Reynolds**

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(54) **BODY FORM-FITTING RAINWEAR**

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(51) **Int. Cl.**
***A41D 31/02*** (2006.01)
***A41D 3/04*** (2006.01)

(52) **U.S. Cl.** ..... **2/87**; 2/82; 2/69

(58) **Field of Classification Search** ..... 2/455–457, 2/51, 69, 69.5, 79, 78.1, 904, 901, 97, 114, 2/171, 202, 84, 200.1, 167, 400, 402, 403, 2/406, 227, 238, 239, 275, DIG. 1, DIG. 5, 2/87, 85, 82, 93, 106, 108, 113, 115, 243.1, 2/272; 428/304.4, 311.11, 315.9, 913, 308.4, 428/315.5; 442/77, 80, 85, 86, 88, 82
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 34,890 | A | | 4/1862 | Knight |
| 3,870,593 | A | | 3/1975 | Elton et al. |
| 4,194,041 | A | * | 3/1980 | Gore et al. ..... 442/289 |
| 4,430,759 | A | | 2/1984 | Jackrel |
| 4,443,511 | A | | 4/1984 | Worden et al. |
| 4,454,191 | A | * | 6/1984 | von Blucher et al. ..... 442/224 |
| 4,469,744 | A | | 9/1984 | Grot et al. |
| 4,507,880 | A | | 4/1985 | Ohashi |
| 4,518,650 | A | | 5/1985 | Grot et al. |
| 4,545,841 | A | | 10/1985 | Jackrel |
| 4,550,446 | A | | 11/1985 | Herman |
| 4,599,810 | A | | 7/1986 | Sacre |
| 4,613,544 | A | | 9/1986 | Burleigh |
| 4,819,345 | A | | 4/1989 | Mulcahy et al. |
| 4,829,683 | A | | 5/1989 | Chikamori |

(Continued)

OTHER PUBLICATIONS

"W.L. Gore & Associates Unveils Next Generation Of Windstopper N2S™ Fabric Collection For Lightweight And Midweight Garments", GORE-TEX and WINDSTOPER Fabrics 2001 Press Release, Sep. 10, 2001, p. 1.

(Continued)

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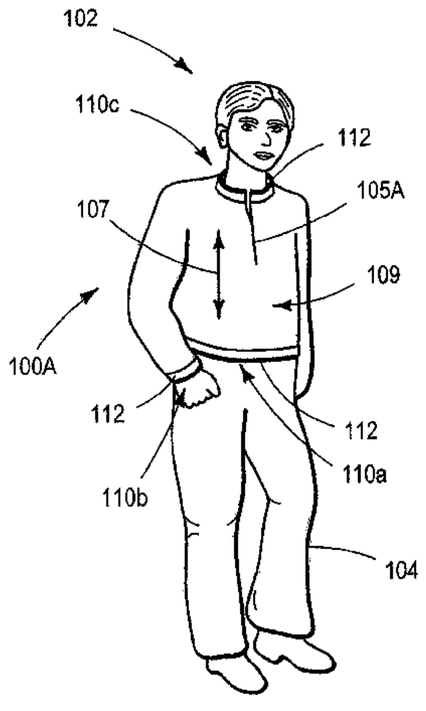
(57) **ABSTRACT**

A body form-fitting rainwear is provided. In the rainwear, a first waterproof layer comprises a polymer material treated with an oleophobic composition to form an air permeable polymer material. The first waterproof layer couples to a first fabric layer. The first fabric layer faces the body and couples to a first side of the first waterproof layer. The first waterproof layer and first fabric layer are formable about a human body and are constructed and arranged to accommodate one or more human appendages. The rainwear may for example form a shirt, pant, underwear, long underwear, hat, hood or one-piece body suit.

**18 Claims, 6 Drawing Sheets**



U.S. PATENT DOCUMENTS

| | | | | | |
|---|---|---|---|---|---|
| 4,833,026 | A | | 5/1989 | Kausch | |
| 4,856,207 | A | | 8/1989 | Datson | |
| 4,899,465 | A | | 2/1990 | Bleimhofer et al. | |
| 4,918,981 | A | | 4/1990 | Gore | |
| 4,932,078 | A | | 6/1990 | Jones et al. | |
| 5,022,109 | A | | 6/1991 | Pekar | |
| 5,026,591 | A | | 6/1991 | Henn et al. | |
| 5,158,636 | A | | 10/1992 | Groitzsch et al. | |
| 5,236,769 | A | * | 8/1993 | Paire | 428/196 |
| 5,244,716 | A | * | 9/1993 | Thornton et al. | 428/198 |
| 5,260,360 | A | * | 11/1993 | Mrozinski et al. | 524/95 |
| 5,289,644 | A | | 3/1994 | Driskill et al. | |
| 5,342,434 | A | * | 8/1994 | Wu | 96/13 |
| 5,364,678 | A | * | 11/1994 | Lumb et al. | 428/96 |
| 5,402,540 | A | | 4/1995 | Williams | |
| 5,409,761 | A | | 4/1995 | Langley | |
| 5,426,869 | A | | 6/1995 | Gore et al. | |
| 5,480,455 | A | * | 1/1996 | Norvell | 623/36 |
| 5,505,011 | A | | 4/1996 | Bleimhofer | |
| 5,526,532 | A | * | 6/1996 | Willard | 2/69 |
| 5,526,584 | A | | 6/1996 | Bleimhofer et al. | |
| 5,539,072 | A | * | 7/1996 | Wu | 526/304 |
| 5,593,754 | A | * | 1/1997 | Blauer et al. | 428/131 |
| 5,596,770 | A | | 1/1997 | Kunesh | |
| 5,628,127 | A | | 5/1997 | Notzold | |
| 5,640,718 | A | * | 6/1997 | Aldridge | 2/81 |
| 5,642,573 | A | | 7/1997 | Brown | |
| 5,685,091 | A | | 11/1997 | Yalamanchili | |
| 5,689,903 | A | | 11/1997 | Aumann | |
| 5,690,949 | A | * | 11/1997 | Weimer et al. | 424/402 |
| 5,700,544 | A | * | 12/1997 | Goodwin et al. | 428/76 |
| 5,732,413 | A | | 3/1998 | Williams | |
| 5,732,480 | A | | 3/1998 | Notzold | |
| 5,786,058 | A | * | 7/1998 | Megchelsen et al. | 428/57 |
| 5,804,011 | A | | 9/1998 | Dutta et al. | |
| 5,832,539 | A | | 11/1998 | Williams | |
| 5,925,441 | A | | 7/1999 | Blauer et al. | |
| 5,933,984 | A | | 8/1999 | Carlson et al. | |
| 5,964,047 | A | | 10/1999 | Covatch | |
| 5,981,019 | A | | 11/1999 | Goodwin et al. | |
| 5,981,038 | A | * | 11/1999 | Weimer et al. | 428/198 |
| 5,992,054 | A | | 11/1999 | Rauch | |
| 6,018,819 | A | * | 2/2000 | King et al. | 2/69 |
| 6,040,251 | A | | 3/2000 | Caldwell | |
| 6,074,738 | A | * | 6/2000 | von Fragstein et al. | 428/315.9 |
| 6,092,305 | A | | 7/2000 | Troy et al. | |
| 6,235,662 | B1 | * | 5/2001 | Zehnder | 442/223 |
| 6,336,221 | B1 | * | 1/2002 | Blauer et al. | 2/87 |
| 2001/0008672 | A1 | * | 7/2001 | Norvell et al. | 428/90 |

OTHER PUBLICATIONS

"Transition Fleece One layer does the work of three", http://www.mountainhardwear.com/clothes/transition.html, Sep. 10, 2001, p. 1.
"Vapor Barrier: Benefits of Vapor Barrier", http://www.warmlite.com/vb.htm, Sep. 10, 2001, pp. 1-3.
"Vapor Barrier Clothing: Stephenson no Sweat Shirt", http://www.warmlite.com/vb_shirt.htm, Sep. 10, 2001, pp. 1-2.
"Warmlite Triple Bags", http://www.warmlite.com/Bags.htm, Sep. 10, 2001, pp. 1-5.
"Ponchos and Rain Jackets: Related Subject:Rain Gear", http://www.warmlite.com/ponchos.htm, Sep. 10, 2001, p. 1.
"Better Than the Skin You're in", advertisement, 3 pages, undated.
Related U.S. Appl. No. 10/316,343, Restriction Requirement, mailed Sep. 27, 2004.
Related U.S. Appl. No. 10/316,343, Response to Restriction Requirement of Sep. 27, 2004.
Related U.S. Appl. No. 10/316,343, Office Action, mailed Jun. 2, 2005.
Related U.S. Appl. No. 10/316,343, Response to Office Action of Jun. 2, 2005.
Related U.S. Appl. No. 10/316,343, Notice of Non-Responsive Reply, mailed Feb. 22, 2005.
Related U.S. Appl. No. 10/316,343, Response to Notice of Non-Responsive Reply of Feb. 22, 2005.
Related U.S. Appl. No. 10/316,343, Office Action, mailed Feb. 22, 2006.
Related U.S. Appl. No. 10/316,343, Response to Office Action of Feb. 22, 2006.
Related U.S. Appl. No. 10/316,343, Notice of Allowance, mailed Sep.7, 2006.

* cited by examiner

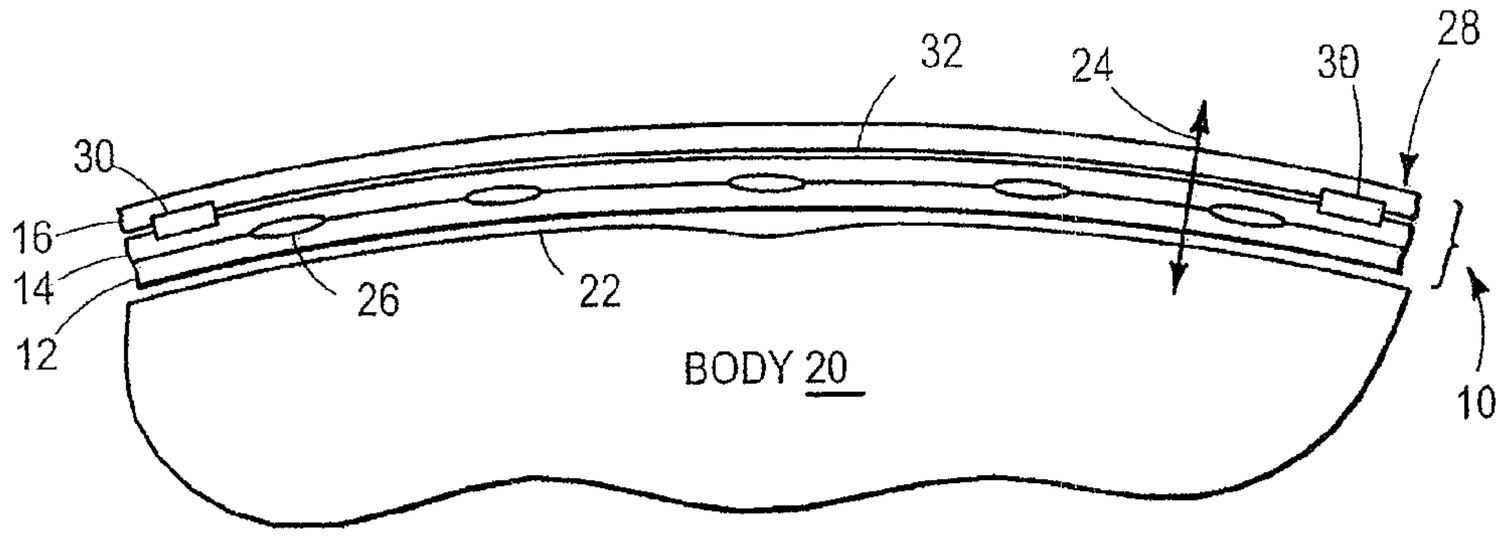



FIG. 1A

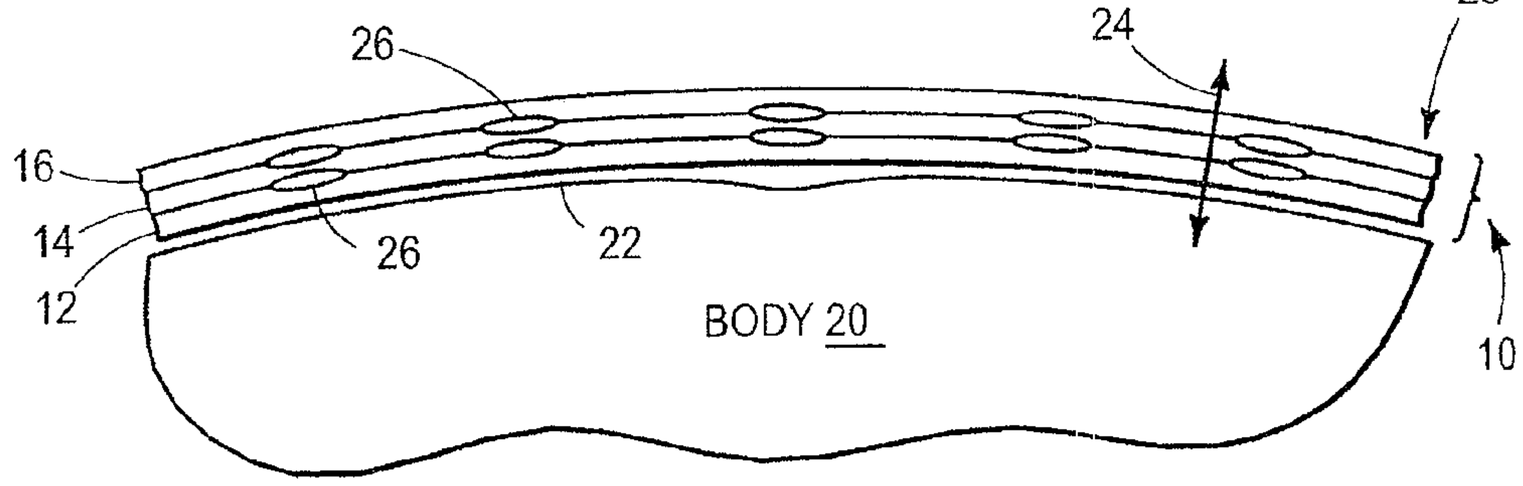



FIG. 1B

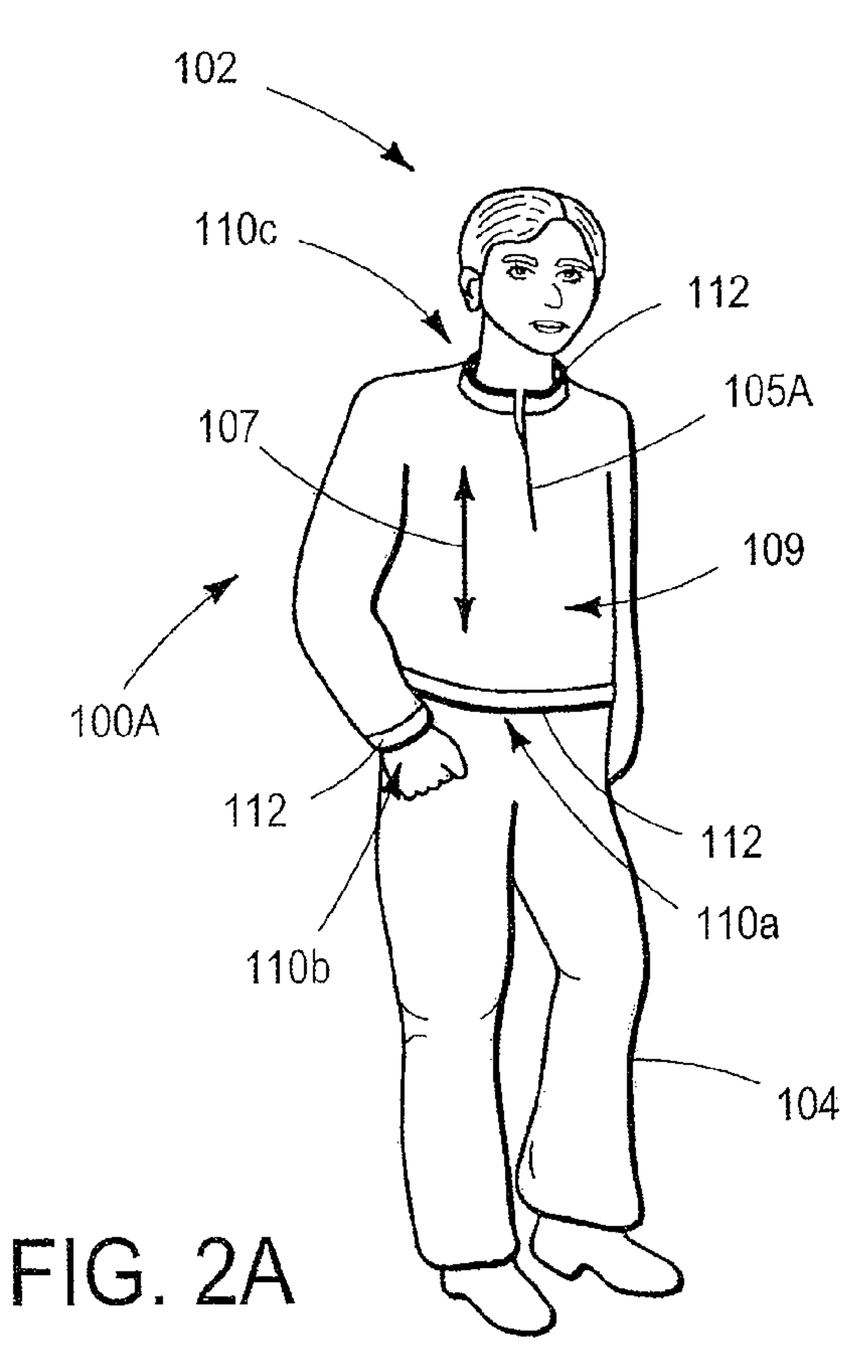



FIG. 2A

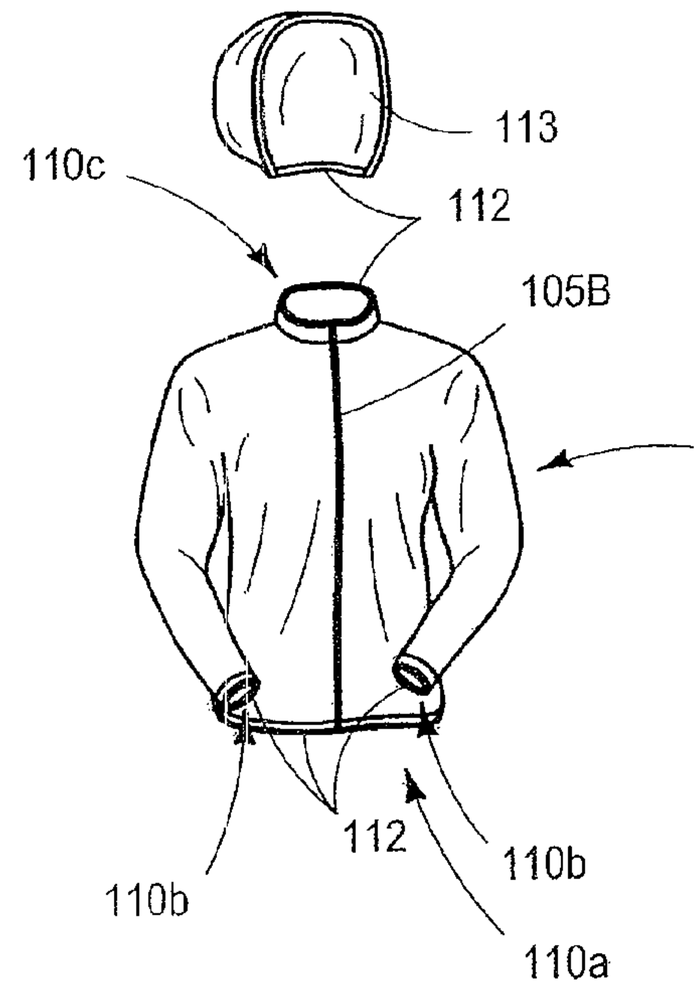



FIG. 2B

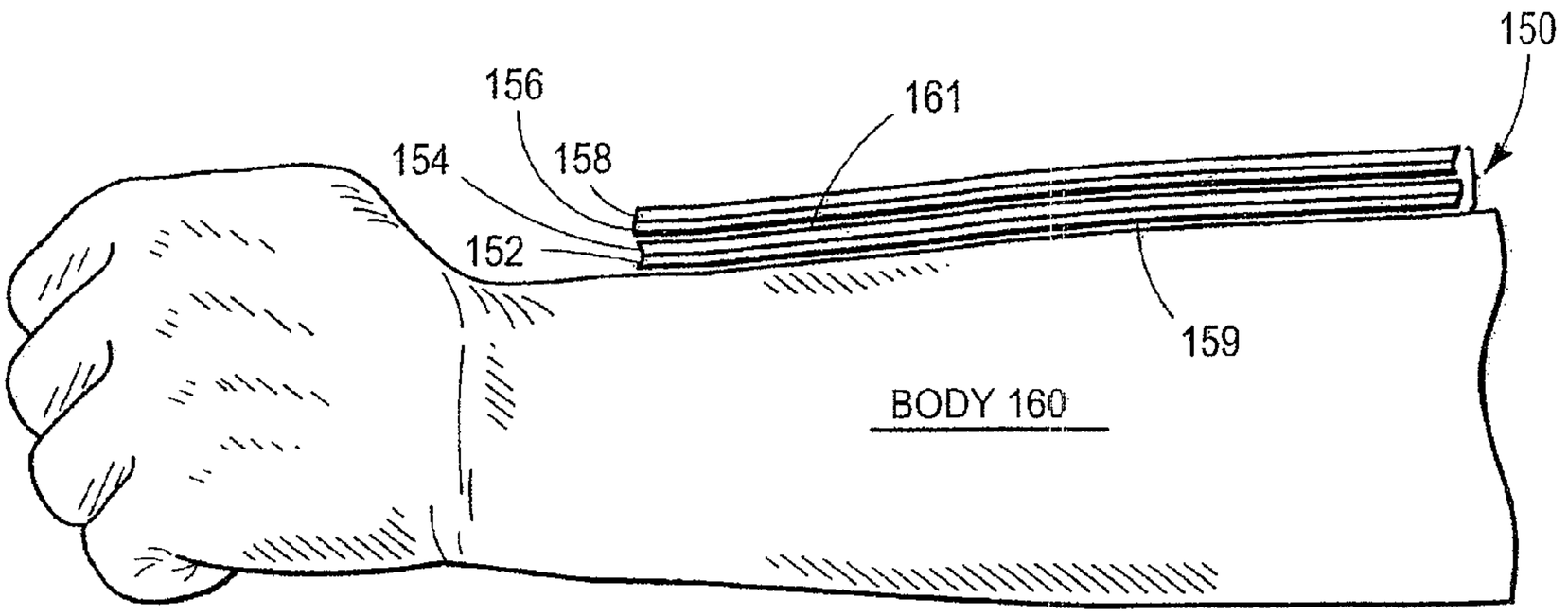
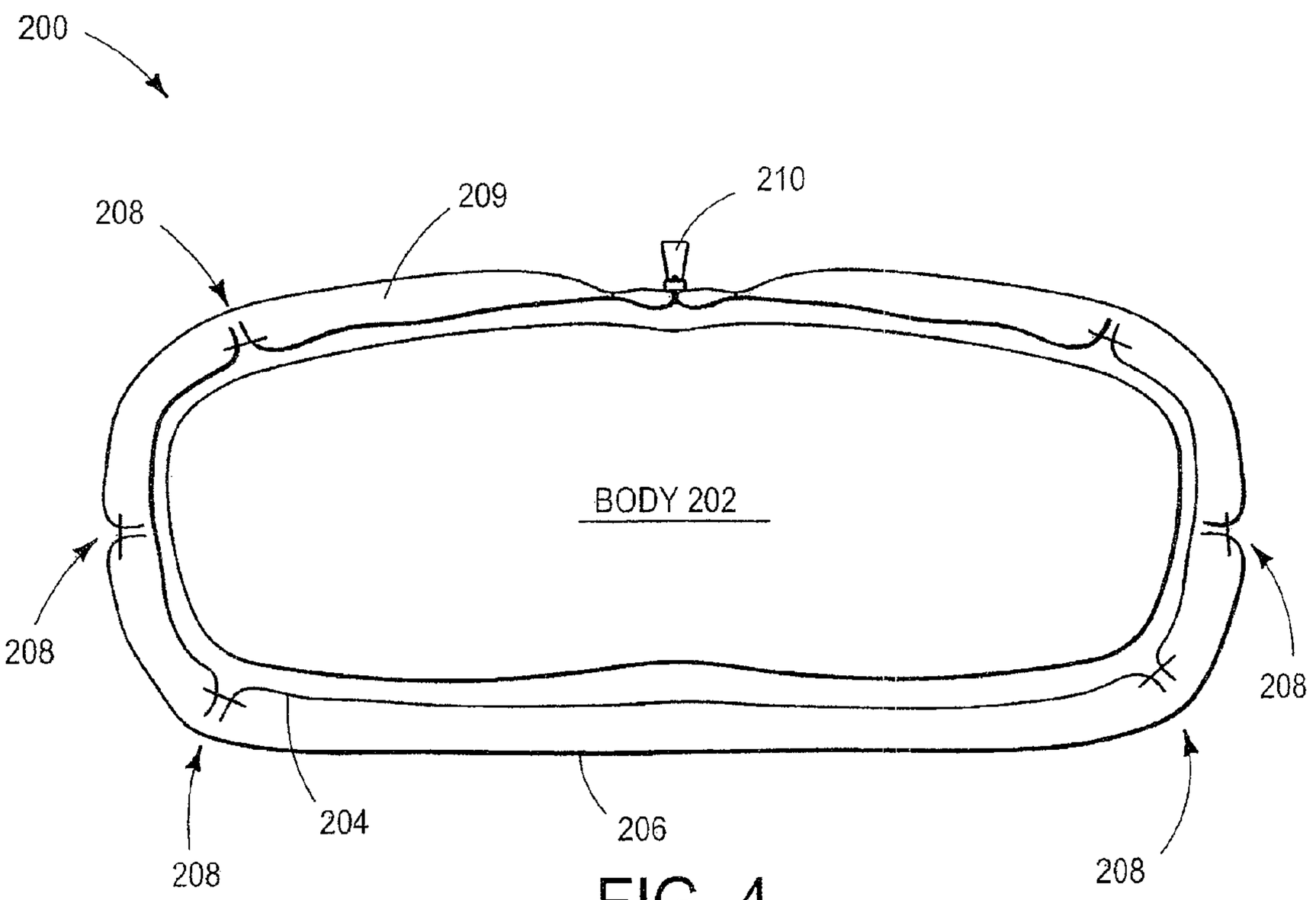

150
156
161
154
158
152
159
BODY 160

FIG. 3


200
208
209
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BODY 202
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204
206
208

FIG. 4

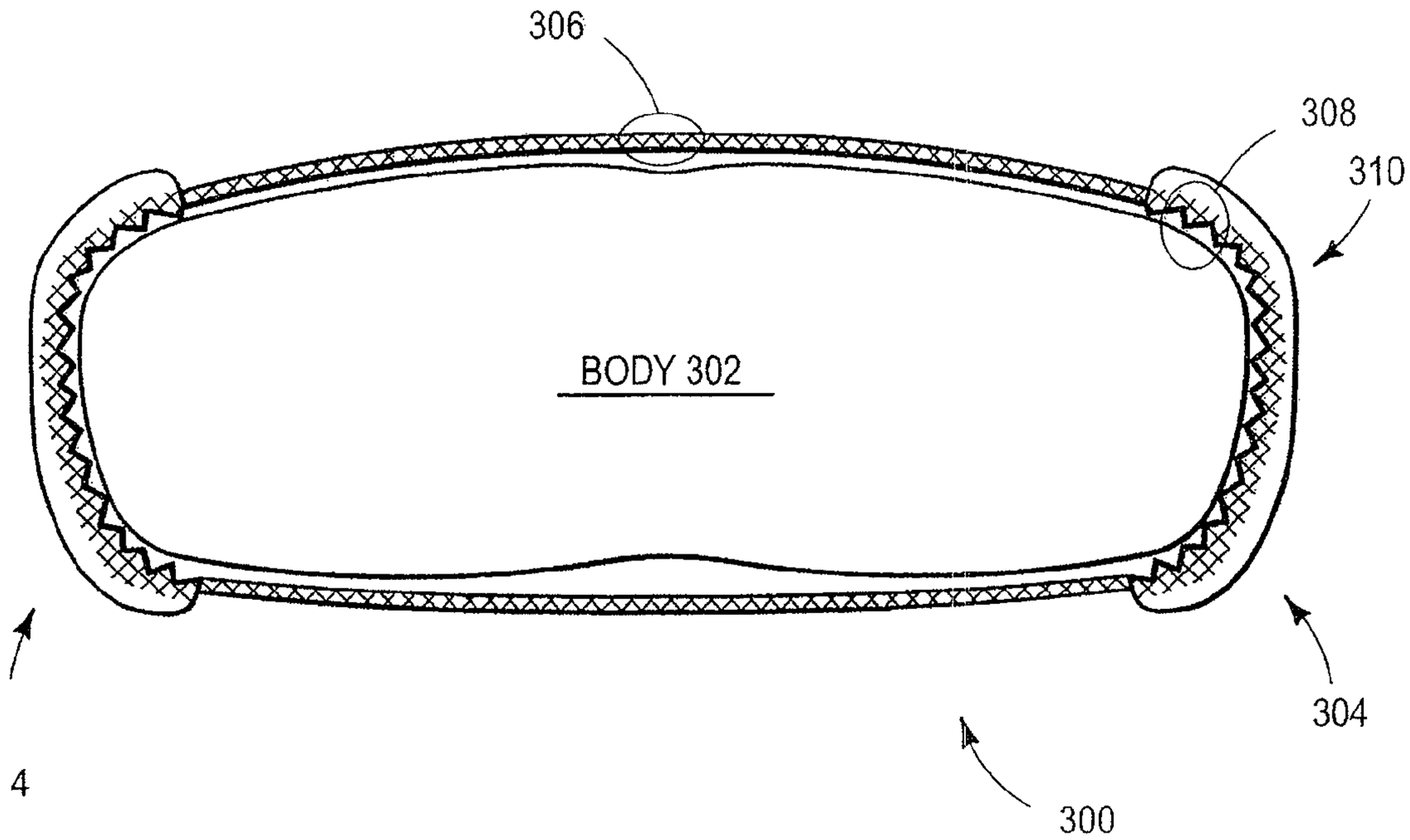


FIG. 5A

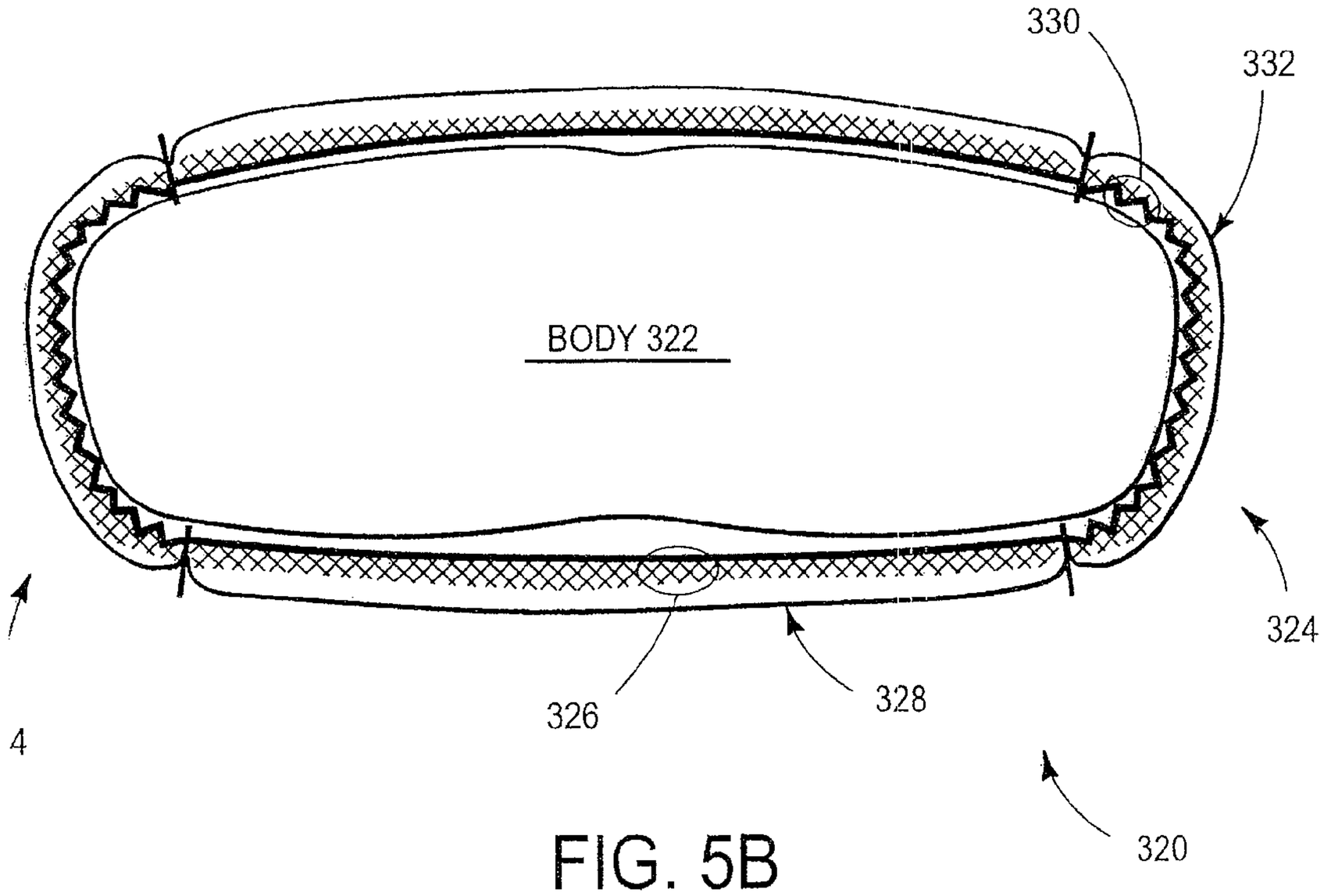


FIG. 5B

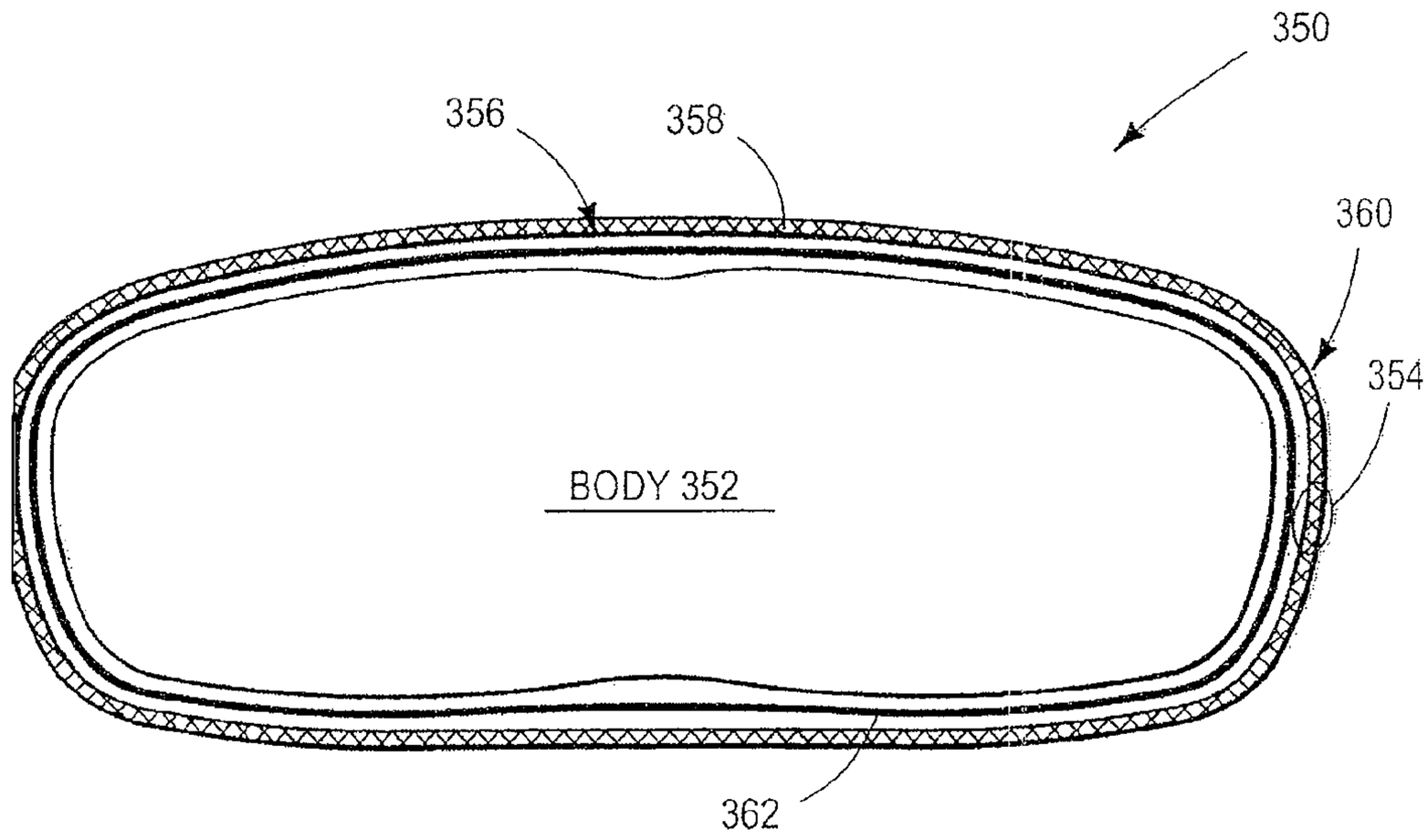


FIG. 6

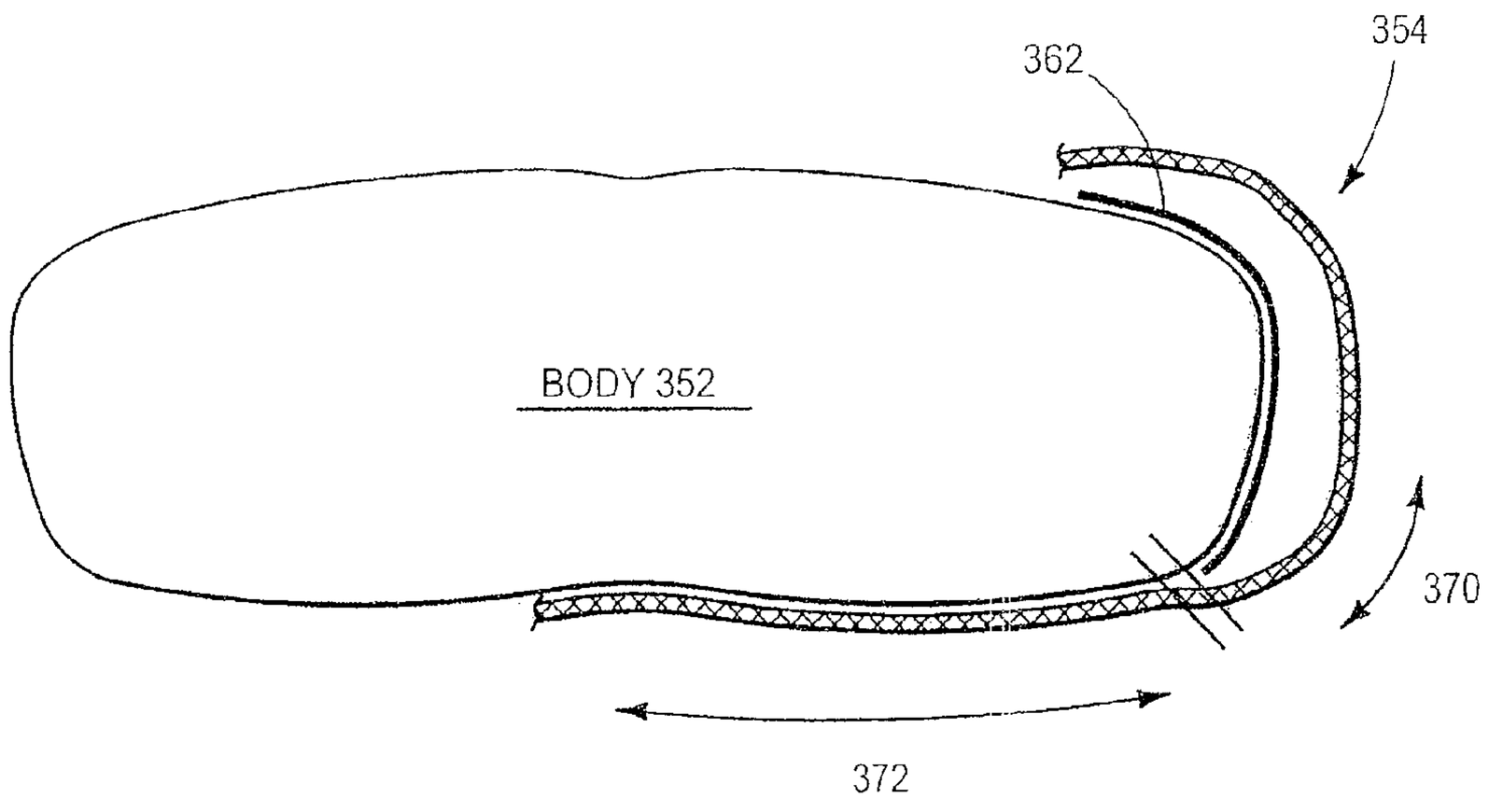


FIG. 7

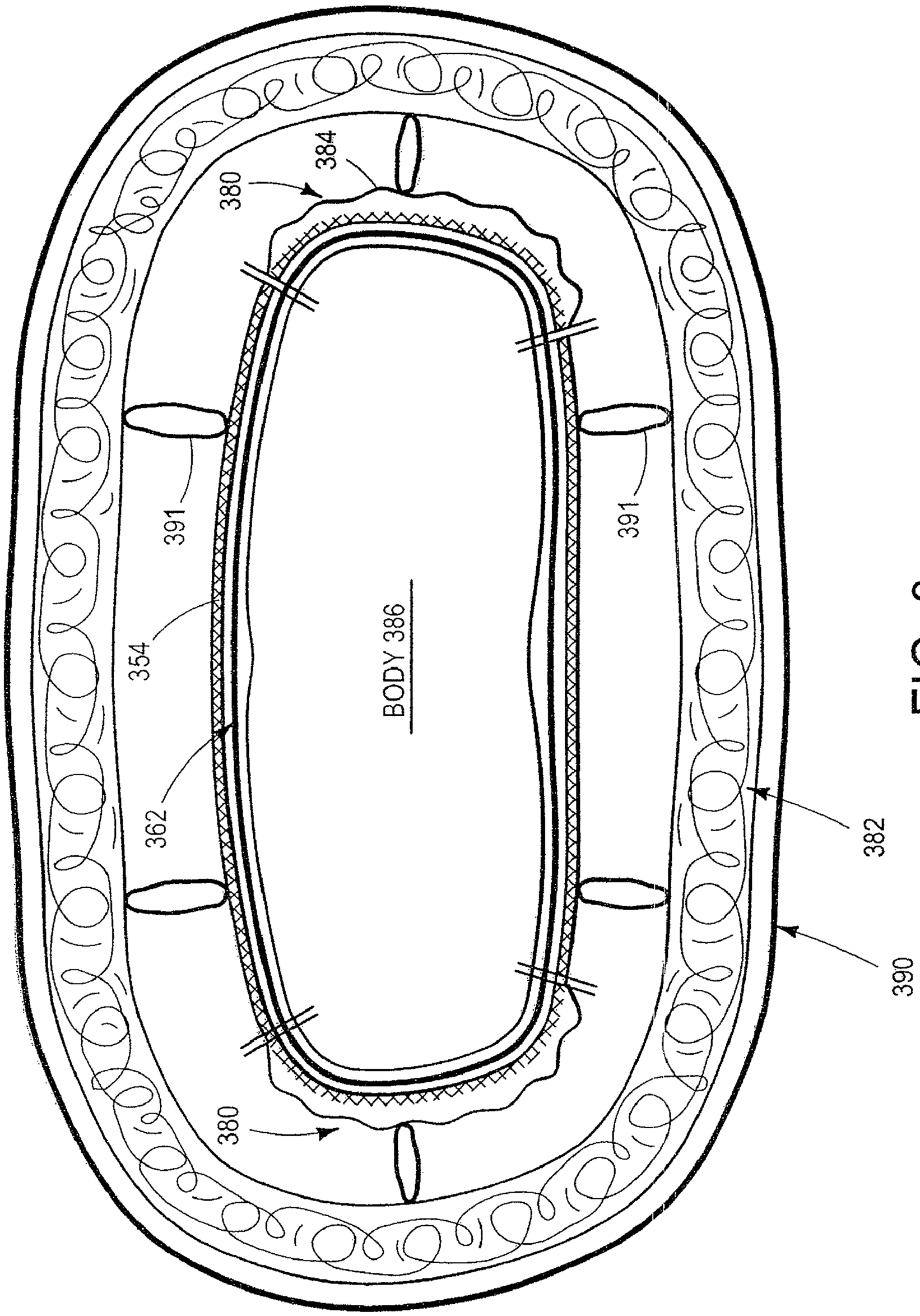


FIG. 8

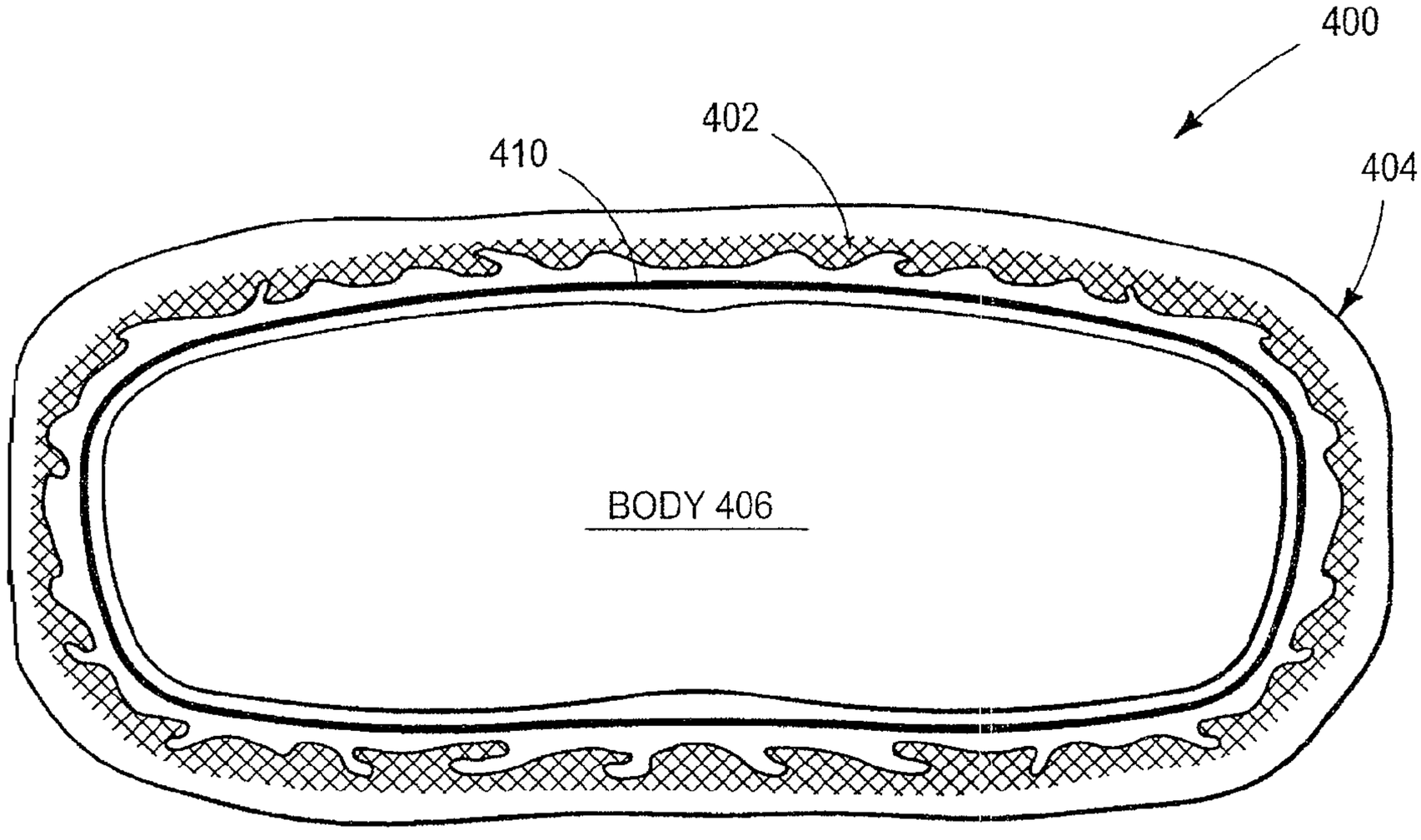


FIG. 9

# BODY FORM-FITTING RAINWEAR

## RELATED APPLICATIONS

This application is a continuation application of U.S. application Ser. No. 10/316,343, filed Dec. 11, 2002, now U.S. Pat. No. 7,162,746 which claimed priority to U.S. Application No. 60/340,686, filed Dec. 12, 2001, each of which is incorporated herein by reference.

## BACKGROUND

The prior art is familiar with various forms of rainwear. However, much of this rainwear is uncomfortable because the rainwear does not efficiently transmit water vapor away from the body. Prior art rainwear can also be bulky and uncomfortable to wear, as it is generally the outer most layer of a multi-layer system that provides the rain protection.

## SUMMARY

As used herein, moisture vapor transmission rate (MVTR) means the amount of moisture vapor transmission through a fabric as measured by the JIS-1099-B2 method.

As used herein, waterproof penetration or resistance in "psi" means that the material withstands water penetration to at least the stated pounds per square inch as measured by the Mullen test method.

As used herein, "hydrophilic" means a material that absorbs water.

As used herein, "hydrophobic" means a material that will not absorb water.

As used herein, "substantially hydrophobic" means that a material will gain no more than 10% in water weight when fully saturated by water.

As used herein, expanded polytetrafluoroethylene with a hydrophobic oleophobic treatment may be manufactured according to GORE-TEX® XCR® 3-LAYER Fabric and BHA eVENT™ Fabric technology known in the art.

As used herein, "form fit" means a material that fits close to the body but does not restrict freedom of movement. Preferably, a "form fit" material also allows other garments to fit over it comfortably.

As used herein, "skin tight" means a clothing material that substantially contacts human skin, throughout the full internal area of the material, when worn by a user.

As used herein, "adhesive dots" are formed of glue which couples two layers of material together.

As used herein, "termination" implies a clothing item with only one aperture, like a glove. Once an appendage (e.g., a hand) enters terminated clothing, like a glove, then that appendage may only leave the clothing, generally, back through the same aperture. "Non-terminated" implies clothing such as pants, long underwear, underwear, one-piece body suits, and shirts, where several apertures permit use of the clothing around the human appendages and without termination.

In one aspect, non-terminated, multi-aperture body form-fitting rainwear is provided. In the rainwear, a first waterproof moisture vapor permeable hydrophobic layer couples to a first fabric layer. The first fabric layer faces the body and couples to a first side of the first waterproof moisture vapor permeable hydrophobic layer. The first waterproof moisture vapor permeable hydrophobic layer and first fabric layer are formable about a human body and are constructed and arranged with multiple apertures to accommodate, without termination, two or more human appendages. This aspect may for example form a shirt, pant, underwear, long underwear and a one-piece body suit.



In accord with one aspect, the inner hydrophobic fabric layer pulls sweat off the body by wicking action to spread over a large surface area in order to facilitate a rapid transfer of moisture through the layers. This function may be accomplished by surface treatments with the fiber providing capillary action. Polyester is one such hydrophobic material and an ideal synthetic.

In one aspect, the waterproof hydrophobic layer resists water penetration to at least 2 psi, and preferably at least 10 psi.

In one preferred aspect, the body form-fitting rainwear includes two key features as compared to the prior art:

1. The rain barrier is close to the body and underneath other layers that provide insulation, wind, and water repellent functions.
2. The rainwear is not based upon a "wet system" technology, known in the art. Wet systems utilize a hydrophilic component in the waterproof layer to aid in the movement of water through the material. By having a hydrophilic layer in the system, liquid water is retained in the material. This water is undesirable in close proximity to the body as liquid water conducts heat away from the body at a very high rate, increasing heat loss.

However, hydrophilic layers may also be used. In one aspect, non-terminated, multi-aperture body form-fitting rainwear is provided. In the rainwear, a first waterproof moisture vapor permeable hydrophilic layer couples to a first fabric layer. The first fabric layer faces the body and couples to a first side of the first waterproof moisture vapor permeable hydrophilic layer. The first waterproof moisture vapor permeable hydrophilic layer and first fabric layer are formable about a human body and are constructed and arranged with multiple apertures to accommodate, without termination, two or more human appendages. This aspect may for example form a shirt, pant, underwear, long underwear and a one-piece body suit.

In accord with one aspect, the inner hydrophilic fabric layer pulls sweat off the body by wicking action to spread over a large surface area in order to facilitate a rapid transfer of moisture through the layers. This function may be accomplished by surface treatments with the fiber providing capillary action.

In another aspect, the layer adjacent human skin is a "bicomponent" knit. The bicomponent knit "wicks" sweat off the body, and the moisture is then pulled to the second side of the knit where it spreads over a larger surface area adjacent the waterproof layer. The spreading occurs because (a) there is a stronger wicking finish on the outer knit side (so there is a differential wicking factor between the two yarns), and/or (b) the first part of the bicomponent is comprised of yarns with a certain number of filaments and a second part of the bicomponent is comprised of yarns with a greater number of filaments which have a much higher surface area (hence a stronger capillary action).

In another aspect, the rainwear includes an outer hydrophobic fabric layer coupled to a second side of the waterproof hydrophilic layer for protecting the first waterproof hydrophilic layer and the first fabric layer. The outer fabric layer does not interfere with the apertures and is generally selected from the group consisting of woven, knit, or non-woven material(s). The outer hydrophobic fabric is ideally non-wicking but it should have a strongly water repellant finish on the hydrophobic layer. It may, for example, be polyester or nylon treated with water repellant chemicals (such as fluorocarbons

or silicones) so that penetrating rain generally stays off of the membrane layer (i.e., the hydrophilic layer).

The rainwear may be extended, in another aspect, by two additional layers. A second waterproof moisture vapor permeable hydrophobic (or hydrophilic) layer has a first side coupled to a second side of the first waterproof hydrophilic layer. A second fabric layer couples to a second side of the second waterproof moisture vapor permeable hydrophobic (or hydrophilic) layer. The first and second waterproof moisture vapor permeable hydrophobic (or hydrophilic) layers and the first and second fabric layers are formable about a human body and are constructed and arranged with multiple apertures to accommodate, without termination, two or more human appendages.

In still another aspect, the coupling of these four layers includes utilizing new and novel waterproof seams, as described herein.

The rainwear disclosed herein provides several advantages over existing rainwear. Since the waterproof layer is next to the body, it is protected from the wear and tear of use. There is less chance of the waterproof layer losing its protection because it most commonly will function as an "internal" layer, which is more easily protected from the abrasions, punctures, rips, and tears experienced by outer clothing. Moreover, the waterproof/breathable barrier is placed in close proximity to the heat engine of the body where the driving forces that power the transmission of water vapor are most powerful. Accordingly, once the water vapor has been pushed through the close-to-body waterproof layer, that vapor will not go back into contact with the body and contribute to conductive or evaporative heat loss. Additionally, a garment construction in a body form-fitting, or skin tight, design uses less fabric and is hence less expensive to produce. The rainwear also does not generally include pockets, flaps or decorative styling features. As well, an internal rain garment as described herein will allow for greater freedom of movement than traditional rainwear used as the outer layer in a clothing layering system.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A illustrates one two-layer rainwear laminate coupled with an outer layer, according to an embodiment.

FIG. **1**B illustrates one three-layer rainwear laminate, according to an embodiment.

FIG. **2**A illustrates one exemplary non-terminated, multi-apertured article of rainwear, as displayed on a person.

FIG. **2**B illustrates another exemplary non-terminated, multi-apertured article of rainwear, and a terminated hood.

FIG. **3** illustrates a four-layer rainwear laminate, according to an embodiment.

FIG. **4** shows one exemplary rainwear utilizing the four-layer laminate of FIG. **3**.

FIG. **5**A shows one exemplary body form-fitting rainwear construction.

FIG. **5**B shows one exemplary body form-fitting rainwear construction.

FIG. **6** shows one exemplary body form-fitting rainwear construction.

FIG. **7** shows the rainwear of FIG. **6** in snug or loosely fitting configurations.

FIG. **8** shows one exemplary body form-fitting rainwear construction.

FIG. **9** shows one exemplary body form-fitting rainwear construction.

## DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1**A shows one rainwear **10** that protects a human body **20** from rain. Rainwear **10** is shown with three-layers: layer **12** is an inner fabric layer adjacent to the skin of body **20**, layer **14** is a waterproof moisture vapor permeable hydrophobic layer, and layer **16** is optional and represents an outer fabric layer. Rainwear **10** is preferably "form fit" to the body. That is, if rainwear **10** is "skin tight", the spacing **22** between body **20** and rainwear **10** is essentially zero millimeters. If rainwear **10** is loosely fitted to body **20**, then spacing **22** may be up to about twenty-five millimeters. Those skilled in the art will appreciate that gap **22** is illustrative and that gap **22** may vary throughout in interfacing between rainwear **10** and body **20**. Specifically, rainwear **10** may contact body **20** in some locations even though a gap exists, on average, for the whole interface between body **20** and rainwear **10**. When rainwear **10** is skin tight, it essentially eliminates gaps **22**, **32**.

Generally, rainwear **10** has a MVTR of 5,000 or more, to provide comfort. Layer **14** may, for example, be made from expanded polytetrafluoroethylene with a hydrophobic air permeable oleophobic treatment, or from expanded polytetrafluoroethylene with a hydrophilic oleophobic treatment. Layer **14** may also be a polyurethane, polyolefin, or a waterproof polymer layer. Layer **14** absorbs less than 30%, and preferably less than 10% in water weight when fully saturated by water. In one embodiment, layer **14** absorbs less than 1%, and preferably less than 0.001% in water weight when fully saturated by water. Layer **12** may be a knitted (e.g., a plaited knit), woven or non-woven fabric; preferably, layer **12** is a bicomponent knit. Layer **16** may, for example, be a nylon, polyester, acrylic, polypropylene, polyolefin or synthetic fiber material.

Along direction **24**, layer **14** has a thickness generally less than 2 mm. Layer **12** may couple to layer **14** by glue or adhesive dots **26**, as shown. Outer layer **16** is preferably sewn to layer **14**, using sewing material **30**, at the perimeter **28** of rainwear **10**. Only a small air gap **32** generally exists between layer **14** and layer **16**. Gap **32** is, for example, generally less than twenty millimeters, and preferably less than two millimeters. Layer **16** may alternatively be in direct contact with layer **14**. Those skilled in the art will appreciate that gap **32** is illustrative, and that gap **32** may vary throughout in interfacing between layer **14** and layer **16**. Specifically, outer layer **16** may also contact layer **14** in some locations even though a gap **32** exists, on average, for the whole interface between layer **14** and layer **16**. Outer layer **16** may also be designed for direct contact with layer **14**, thereby eliminating gap **32**.

It should be obvious to those skilled in the art that rainwear **10** "surrounds" the body as "near-to-body" clothing and that FIG. **1**A is simplified for illustrative purposes. Moreover, elements of the drawings may not be drawn to scale.

In one embodiment, and as shown in FIG. **1**B, outer layer **16** also couples with layer **14** through a plurality of glue or adhesive dots **26**, similar to those used to couple layers **12** and **14**, thereby eliminating gap **32**. Such rainwear may be called a "three-layer laminate" herein.

In one embodiment, layer **14** of FIGS. **1**A, **1**B is instead a waterproof moisture vapor permeable hydrophilic layer.

FIG. **2**A shows one rainwear item **100**A in the form of a long sleeve shirt, worn on a user **102**. User **102** may wear item **100**A on his body **104** such that item **100**A interfaces with body **104** like rainwear **10** to body **20**, FIGS. **1**A, **1**B. Item **100**A is "non-terminated" so that it forms around body **104** with apertures **110***a*, **110***b*, **110***c* accommodating, respectively, the torso, hands and head of body **104**. Preferably, item **100**A includes waterproof seam tape **112** at all or most of the

seams joining the fabric pieces, in accord with the teachings herein. Rainwear item **100**A is shown with an optional zipper **105**A that partially extends along a direction **107** of the torso **109** of user **102**.

FIG. **2**B shows another rainwear **100**B similar to rainwear **100**A. Rainwear **100**B has an optional zipper **105**B extending the full length of rainwear **100**B. A hood **113** may be worn by user **102**, for example. Hood **113** may be formed of the two-layer or three-layer laminates of FIGS. **1**A, **1**B, and may further include seam tape **112**. Hood **113** may permanently attach to rainwear **100**B or optionally attach with snaps or zippers, as a matter of design choice.

Rainwear **100**A and **100**B of FIG. **2**A and FIG. **2**B, respectively, exemplify rainwear garments formable about a body **104** by the laminates described herein. In the following figures, as in FIGS. **1**A, **1**B, such laminates are shown in cross-sectional views and in partial constructions about the human body for purposes of illustration. Those skilled in the art will appreciate that the laminates may be formed fully or partially about the body and into a desired garment as a matter of design choice.

FIG. **3** shows a four-layer laminate rainwear **150** for protecting a human body **160**. Laminate rainwear **150** has layers **152**, **154**, **156**, **158**. Layers **152** and **154** are the same as layers **12**, **14**, respectively, of FIGS. **1**A, **1**B. Layers **156**, **158** are also similar to layers **12**, **14** of FIGS. **1**A, **1**B. Specifically, layer **156** is a second waterproof moisture vapor permeable hydrophobic layer and layer **158** is a second fabric layer coupled to layer **156**. Layers **156**, **158** maybe coupled together as in layers **12**, **14** of FIGS. **1**A, **1**B. Rainwear laminate **150** may also include an outer layer **16** (not shown in FIG. **3**) as a matter of design choice. As above, a gap **159** may exist between body **160** and layer **152**. A gap **161** may further exist between layers **154** and **156**, and between layer **158** and the outer layer (e.g., layer **16**, if applied to layer **158**). Laminate **152**, **154** is for example coupled to laminate **156**, **158** by a sewing material (e.g., sewing material **30**, FIG. **1**A).

In one embodiment, one or both of layers **154**, **156** of FIG. **3** is instead a waterproof moisture vapor permeable hydrophilic layer.

It should be apparent to those skilled in the art that rainwear **150** is shown in a cross-sectional view, for purposes of illustration, and that rainwear **150** forms about body **160** at the desired region to protect that body region from rain.

FIG. **4** shows another rainwear **200** about a body **202**. Rainwear **200** is made from layers **152**, **154** (shown as a single layer **204**) and layers **156**, **158** (shown as a single layer **206**). Rainwear **200** has offset seams **208** between layers **204**, **206**, as shown, to prevent moisture from directly penetrating any one layer **206**, **208**. A zipper **210** may be used to combine layers **204**, **206** as a useful garment, e.g., a pant, shirt, or long underwear. Rainwear **200** may allow construction of a waterproof garment without seam tape **112**, FIGS. **2**A, **2**B, as a matter of design choice. It should be apparent that FIG. **4** shows a cross-sectional view of rainwear **200** to clearly illustrate layers **204**, **206**, and that zipper **210** operates perpendicular to the plane of the paper.

FIG. **5**A shows another rainwear **300** (in cross-sectional view to illustrate layers of rainwear **300**) about a body **302**. Rainwear **300** has two side panels **304** that stretch about body **302** in creating a snug fit to body **302**. Except for panels **304**, rainwear **300** is made from a three-layer laminate **306**, which has little or no stretching capability. Laminate **306** may include layers **12** and **14**, FIGS. **1**A, **1**B, as the inner-most two layers (with layer **12** closest to body **302**), and an outer layer (e.g., layer **16**). Panels **304**, on the other hand, are made from either a two-layer or three-layer laminate **308** and an outer stretch knit **310**. The inner-most two layers of laminate **308** are for example layers **12**, **14**, FIGS. **1**A, **1**B, again with layer **12** adjacent body **302**. If a third layer exists in laminate **308**, it is for example outer layer **16**. Stretch material **310** may be either knit or woven material that pulls the entire rainwear **300** to body **302** when worn. In one embodiment, layer **308** is the same material laminate as layer **306**, but it is shown "gathering" or "puckering" in response to stretch layer **310** disposed over layer **308**. Laminate **308** differs from laminate **306** at least in that it is loosely fit to body **302**.

FIG. **5**B shows another rainwear **320** about a body **322**. Rainwear **320** has two side panels **324** that stretch about body **322** in creating a snug fit to body **322**. Except for panels **324**, rainwear **320** is made from a two-layer laminate **326**, which has little or no stretching capability. Laminate **326** may include layers **12** and **14**, FIGS. **1**A, **1**B, with layer **12** closest to body **322**. An outer layer **328** covers laminate **326**; layer **328** is either a stretch knit or a stretch woven layer, which may or may not have stretch properties. Panels **324**, on the other hand, are made from either a two-layer or three-layer laminate **330** and an outer stretch knit **332**. The inner-most two layers of laminate **330** are for example layers **12**, **14**, FIGS. **1**A, **1**B, again with layer **12** adjacent body **322**. If a third layer exists in laminate **330**, it is for example outer layer **16**. Stretch knit **332** is a woven material that pulls the entire rainwear **320** to body **322** when worn. Laminate **330** differs from laminate **326** at least in that it is loosely fit to body **322**.

FIG. **6** shows one rainwear **350** about a body **352**. Rainwear **350** includes a three-layer laminate **354**. Laminate **354** may include an inner knit layer **356**, which has little or no stretching capability, an inner waterproof, breathable layer **358**, and an outer knit **360**, also having little or no stretching capability. Layer **358** is, for example, layer **14** of FIGS. **1**A, **1**B. Laminate **354** conforms closely to body **352**. If laminate **354** has some stretching capability, then it may conform tightly to body **352**, e.g., it may be body form-fitting. Inner knit layer **356** may have a smooth sliding texture such as a tricot knit; or it may be a bicomponent knit with some texture. Layer **360** may also be a bicomponent knit.

Optionally, rainwear **350** is configured within an inner underwear layer **362**. Layer **362** couples with layer **356** through techniques such as described with reference to FIGS. **1**A, **1**B. Layer **362** may for example be a bicomponent knit with or without wicking capability.

FIG. **7** illustrates how laminate **354** may fit snugly or loosely about body **352**. With underwear layer **362**, laminate **354** may fit loosely to body **352**, as illustrated by region **370** of FIG. **7**. Without underwear layer **362**, laminate **354** may fit snugly to body **352**, as illustrated by region **372** of FIG. **7**. Laminate **354** is not shown completely around body **352** for purposes of illustration.

In one embodiment, laminate **354** is constructed with a side panel **380** and, optionally, with an outer insulation layer **382**, as shown in FIG. **8**. Laminate **354** and panel **380** together form body-form fitting rainwear about body **386**. Side panel **380** may be made of layers of laminate **354** and an outer stretch knit **384**, to pull the rainwear to body **386**. Insulation layer **382** loosely couples (e.g., with threading **391**) to laminate **354** and panel **380**, and may for example be sweater, fleece, and/or down insulating material of one or more layers. A water repellant layer **390** (or waterproof woven shell **390**) may further cover insulation layer **382**. Accordingly, laminate **354**, panel **380** and insulation layer **382** (and/or layer **390**) form a warm, comfortable clothing with body form-fitting rainwear properties described herein.

FIG. **9** shows one body form fitting rainwear **400** that includes a two-layer laminate **402** and an outer stretch knit or

woven layer **404** to conform laminate **402** to body **406**. Laminate **402** may for example be layers **12**, **14** of FIGS. **1**A, **1**B, with layer **12** closest to body **406**. Laminate **402** has little or no stretching capability (and, by itself would fit loosely over body **406**) so that layer **404** forces laminate **402** against body **406** as body form-fitting rainwear **400**. Optionally, rainwear **400** may include an underwear layer **410**, which may be, for example, a bicomponent knit with or without wicking capability. Rainwear **400** has advantages in that it provides a snug-fit to body **406** but is less expensive to manufacture than existing rainwear because inexpensive layer **404** is separate from laminate **402**.

Changes may be made in the above methods and systems without departing from the scope hereof. It should thus be noted that the matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense. The following claims are intended to cover all generic and specific features described herein, as well as all statements of the scope of the present devices and methods, which, as a matter of language, might be said to fall there between.

What is claimed is:

**1**. Body form-fitting rainwear, comprising:

a first waterproof layer comprising a polymer material treated with an oleophobic composition, wherein the treated polymer material is air permeable, the first waterproof layer coupled to a first fabric layer, the first waterproof layer and the first fabric layer having, in combination, a moisture vapor transmission rate (MVTR) greater than or equal to 5000 grams per square meter per day as measured by test method JIS-1099-B2, the first fabric layer facing the body and coupled to a first side of the first waterproof layer, the first waterproof layer and first fabric layer being formable about a human body and being constructed and arranged to accommodate one or more human appendages, and one or more waterproof seams for sealing joined edges of the first waterproof layer and first fabric layer.

**2**. Rainwear of claim **1**, the polymer material comprising one of polyurethane, polytetrafluoroethylene, polyolefin and polyester.

**3**. Rainwear of claim **1**, the polymer material being substantially hydrophobic.

**4**. Rainwear of claim **1**, the polymer material being hydrophilic.

**5**. Rainwear of claim **1**, the first waterproof layer absorbing less than 10% in water weight when fully saturated by water.

**6**. Rainwear of claim **1**, the first waterproof layer resisting water penetration to at least 10 psi.

**7**. Rainwear of claim **1**, the first fabric layer comprising one of a knitted fabric, a woven fabric, and a non-woven fabric.

**8**. Rainwear of claim **1**, the first fabric layer comprising a bicomponent material.

**9**. Rainwear of claim **1**, the first fabric layer comprising plaited knit.

**10**. Rainwear of claim **1**, the first waterproof layer and the first fabric layer have a combined cross-sectional thickness of less than about 3 mm.

**11**. Rainwear of claim **1**, further comprising an outer fabric layer coupled to a second side of the first waterproof layer for protecting the first waterproof layer and the first fabric layer.

**12**. Rainwear of claim **11**, the outer fabric layer comprising one of a knitted fabric, a woven fabric, and a non-woven fabric.

**13**. Rainwear of claim **11**, the outer fabric comprising one of nylon, polyester, acrylic, polypropylene, polyolefin and synthetic fiber material.

**14**. Rainwear of claim **1**, further comprising a second waterproof layer having a first side coupled to a second side of the first waterproof layer, and a second fabric layer coupled to a second side of the second waterproof layer, the first and second waterproof layers and the first and second fabric layers being formable about a human body and being constructed and arranged to accommodate the one or more human appendages.

**15**. Rainwear of claim **14**, the second waterproof layer being air permeable.

**16**. Rainwear of claim **14**, the second waterproof layer comprising expanded polytetrafluoroethylene with a hydrophobic oleophobic treatment.

**17**. Rainwear of claim **14**, the first and second waterproof layers and the first and second fabric layers having, in combination, a moisture vapor transmission rate (MVTR) greater than or equal to 3500 grams per square meter per day as measured by test method JIS-1099-B2.

**18**. Rainwear of claim **14**, further comprising a first seam joining edges of the first waterproof layer and the first fabric layer, a second seam joining edges of the second waterproof layer with the second fabric layer, the seams being offset from one another to inhibit moisture passage through the rainwear at the seams.

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